Imitation-dynamic model for calculating the efficiency of the financial leverage

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Abstract. The article presents a simulation-dynamic model for calculating the financial leverage efficiency level. The model was developed on the basis of the system dynamics method using Powersim Studio tools. In the constructed model, the calculations were carried out on the example of PJSC «Koks», one of the largest Russian producers and exporters of metallurgical coke. The model was used as a tool to study the capital structure of the enterprise. As a result of the experiments, the level values of financial leverage efficiency, differential of financial leverage and financial leverage ratio were calculated. On the basis of the calculations, the conclusions were made about the quality of management of borrowed capital in the enterprise. In addition the assessment of the developed model of financial leverage efficiency was carried out; as a result of the assessment, both the model advantages and its disadvantages were indicated.

1. Introduction

On modern market conditions, covering the need for financial resources only from our own sources is a difficult task. Almost every company eventually has a need for borrowed funds.

The main problem arising from the decision to raise borrowed capital is the growth of indicators characterizing financial risks. If a commercial organization uses borrowed funds in its activities, then its aggregate financial risk mainly focuses on the owners of the company, who will demand appropriate compensation in the form of increased returns.

As a result, the process of evaluating the effectiveness of the use of borrowed capital is based on a comparison of the following indicators:

- Weighted average cost of borrowed capital
- Return on equity

In the economic literature [1–3] and in practice, much attention is paid to this process. One way to assess the return of borrowed capital is to monitor the level of efficiency of financial leverage.

Management of a commercial organization is faced with the need to determine the level of financial leverage before a decision is made on the parameters of borrowing [3–5]. Economic studies [3–8] show that the value of the indicator of the financial leverage effect is influenced by many factors. According to the authors, the main ones (for enterprises conducting their activities in the Russian Federation) include: tax rates on income tax, industry characteristics, cost of borrowed capital, enterprise scale.

The complexity of taking into account the influence of these factors predetermines the need to use instrumental methods of management, such as economic and mathematical modeling (EMM), which provide an increase in the effectiveness of decisions made to calculate the level of efficiency of financial leverage. One of such modern and widely used approaches today is simulation-dynamic modeling, the method of system dynamics [5, 6, 9, 10].

2. Calculation model of the financial efficiency leverage

Figure 1 presents the graphic diagram of the simulation-dynamic model for calculating the level of financial leverage efficiency.

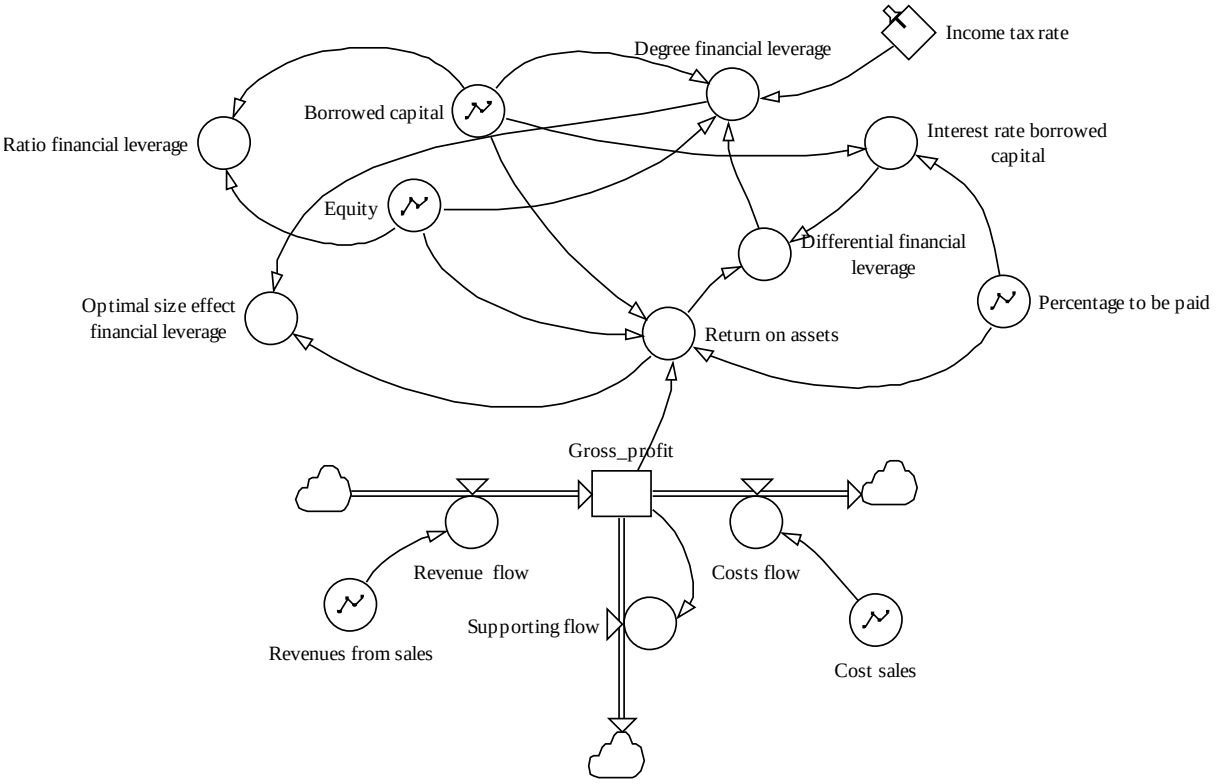

Figure 1. Flow chart and levels of calculation of the level of financial leverage efficiency

The model includes one level (drive): gross profit. The diagram also shows two streams: income and costs. In addition to the listed flows and levels, there are auxiliary variables in the diagram. Interpretation of the variables shown in the diagram is presented in Table 1. The scheme for calculating the level of financial leverage efficiency is presented in Figure 2 [2].

The effect of financial leverage is an increment in the return on equity that comes from using borrowed funds, provided that the economic return on the assets of a company is greater than the interest rate on the loan.

The tax proofreader shows how the change in the income tax rate affects the effect of financial leverage. The profit tax is paid by all legal entities of the Russian Federation, and its rate may vary depending on the type of activity of the organization.

Differential financial leverage (Dif) is the difference between return on assets and leverage rates. In order for the effect of financial leverage to be positive it is necessary that the return on equity be higher than the interest on loans. With a negative financial leverage, the company begins to incur losses, because it can't ensure that the efficiency of production is higher than the payment for borrowed capital. Table 2 shows the values of the differential values obtained in the calculations and comments on them.

Table 1. Used variables in the flow diagram and levels of calculation of the financial leverage efficiency

	Name	Documentation
1	Borrowed capital	Enterpriseloan capital
2	Cost sales	Cost of sales
3	Costs flow	Cost stream
4	Degree financial leverage	The effect of financial leverage
5	Differential financial leverage	Differential financial leverage
6	Equity	Equity capital
7	Gross profit	Gross profit
8	Income tax rate	Income tax rate
9	Interestrate borrowed capital	The estimated interest rate on loans
10	Percentage to be paid	Percentage to be paid
11	Ratio financial leverage	Leverage ratio
12	Return on assets	Return on assets of the company
13	Revenue flow	Revenue stream
14	Revenues from sales	Revenues from sales

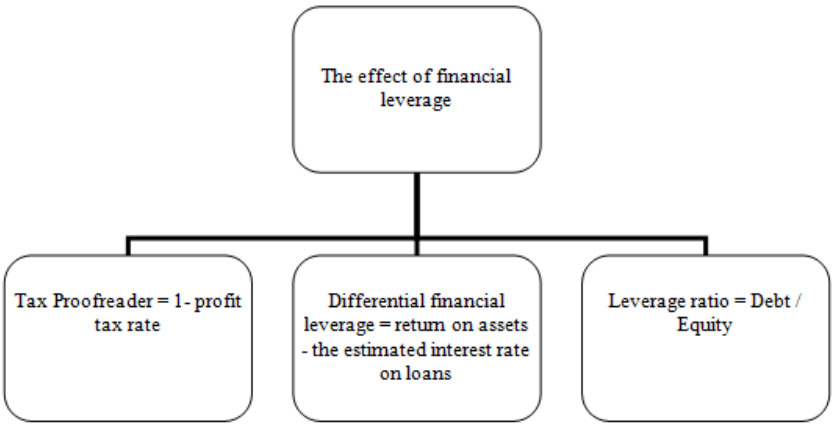

Figure 2. Scheme for calculating the level of financial leverage efficiency

The coefficient of financial leverage shows what share in the total capital structure of an enterprise borrowed funds (loans, loans and other liabilities) occupy, and determines the strength of the influence of borrowed capital on the effect of financial leverage.

On the basis of empirical data [1], the optimal size of leverage (ratio of borrowed and own capital) was calculated for an enterprise, which is in the range from 0.5 to 0.7. This suggests that the share of borrowed funds in the overall structure of the enterprise should be from 50% to 70%.

Table 2. Differential financial leverage

Differential value	Comments
Dif<0	The company quickly accumulates losses
Dif>0	The company increases the size of its profits through the use of borrowed funds
Dif=0	Profitability is equal to the interest rate on the loan, the effect of financial leverage is zero

With the increase in the share of borrowed capital, financial risks increase: the possibility of losing financial independence, solvency and bankruptcy risk. When the size of borrowed capital is less than 50%, the company misses the possibility of increasing profits. The optimal size of the effect of financial leverage is a value equal to 30-50% of the return on assets (ROA).

3. Management interface of the simulation-dynamic model for calculating the level of financial leverage

Figure 3 presents the management interface of the model for calculating the level of financial leverage.

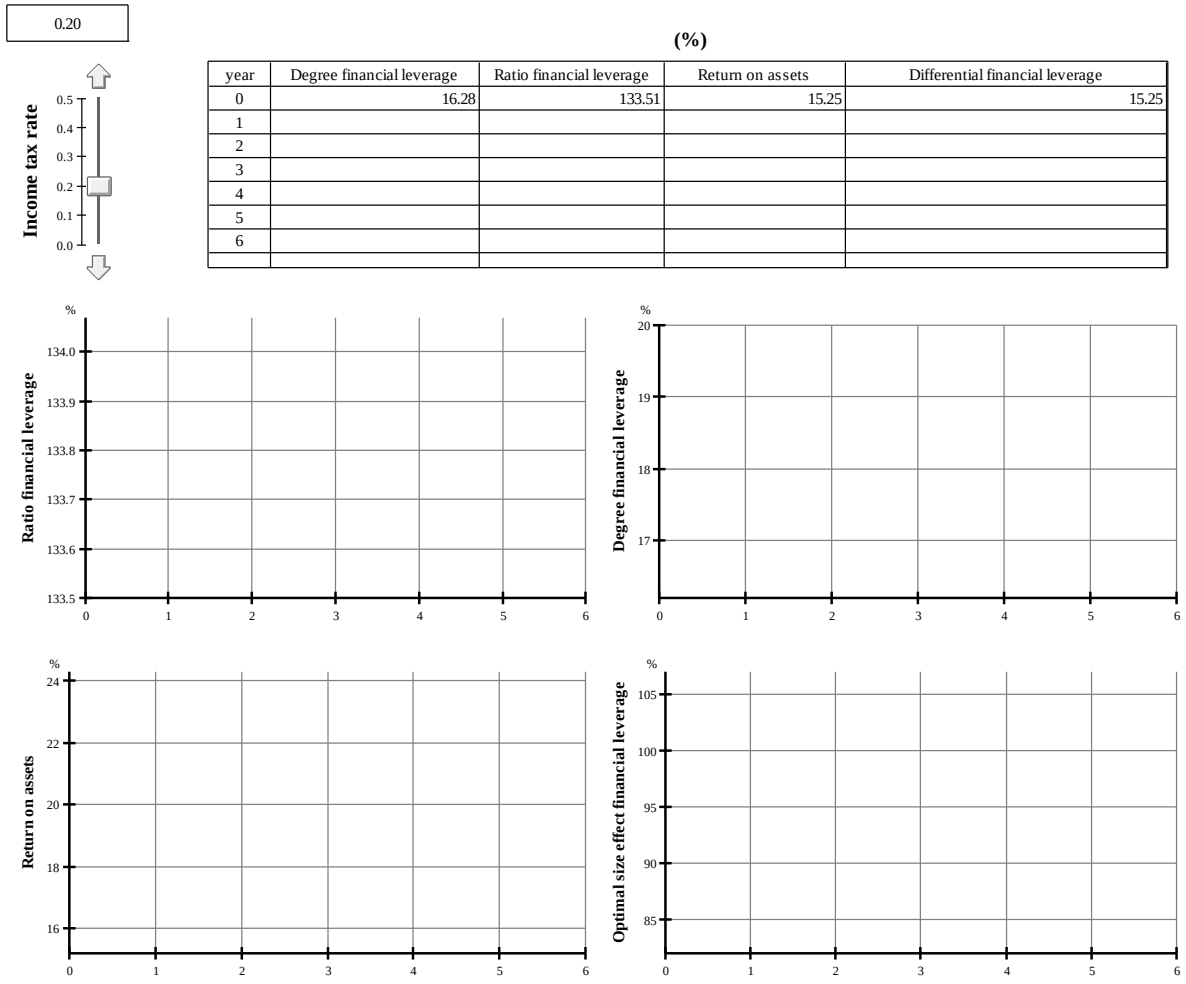

Figure 3. Control panel of the model for calculating the level of financial leverage

The interface structure consists of two parts: input data and monitoring of the calculation results. Before starting the calculation, the following data is entered: income tax rate, loan capital for an enterprise, cost of sold goods, equity of the enterprise, interest payable and revenue from sales. The second part of the interface graphically displays the results of the calculation: the effect of financial leverage, the ratio of financial leverage, the profitability of the company assets.

4. Results

During the experiment, the calculations were made of the level of efficiency of financial leverage on the example of PJSC Cox, one of the largest Russian producers and exporters of metallurgical coke (Figure 4).

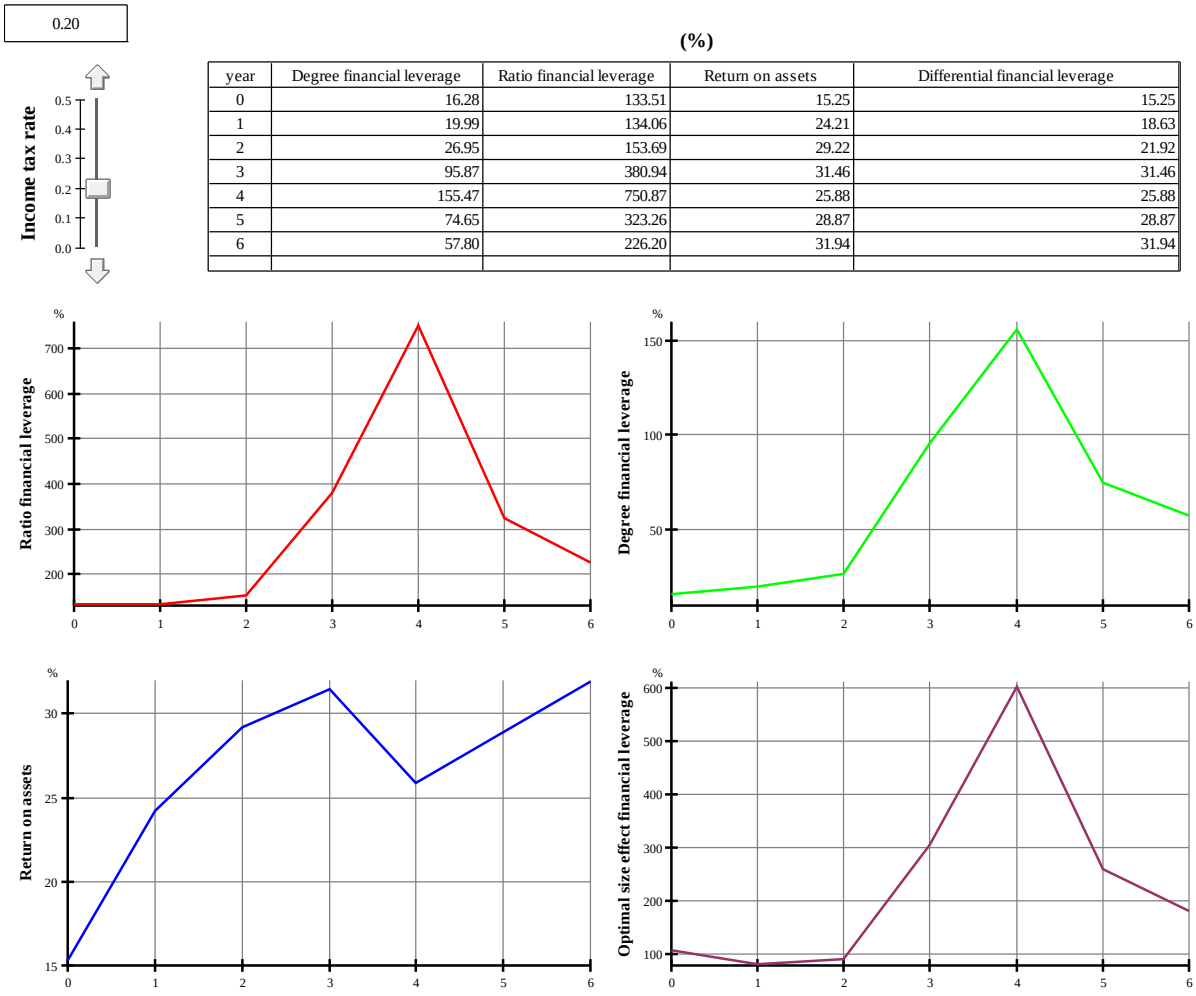

Figure 4. Results of calculating the level of financial leverage efficiency

The initial data for the calculation is received from the balance sheet and income statement prepared in the system of International Financial Reporting Standards (IFRS):

- Calculation period is 7 years.
- The tax rate on profits is 20%

It can be seen from the graphs and the table (figure 4) that the value of the differential of financial leverage is greater than zero, which means that it can be considered a positive effect, as the company increases the amount of profit obtained through the use of borrowed funds. However, the ratio of financial leverage in the calculation period takes values in the range from 133 to 750%, which does not correspond to the optimal value of the leverage (50-70%). The effect of financial leverage also does not correspond to the optimal value; it is in the range from 82 to 600%, while it should be in the range of 30-50%.

5. Conclusion

In accordance with the obtained results, it can be said that the company does not effectively manage the process of attracting borrowed capital, since it significantly exceeds the allowable size, which can lead to a rapid increase in insolvency, and further to bankruptcy.

The constructed model allows managing the ratio of the enterprise borrowed and own capital, due to the calculated values of the level of financial leverage of efficiency, differential and financial leverage ratio. However, the model does not allow determining the optimal capital structure of the

enterprise, i.e. in the future, it is necessary to add an optimization module to the model, which will improve the quality of management of the financial condition of the company.

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